Report On

Radio Testing of the
Delphi Deutschland GmbH
Immobilizer for Keyless Entry System
Model FI6-125kHz

CFR 47 Part 15, Subpart C
RSS-210 Issue 9 and RSS-GEN Issue 4

Report No. SD72120558-0916ARev1.0 **October 2016**

REPORT ON	Radio Testing of the Delphi Deutschland GmbH FI6-125kHz Immobilizer for Keyless Entry System
TEST REPORT NUMBER	SD72120558-0916ARev1.0
PREPARED FOR	Delphi Deutschland GmbH Delphiplatz 1 42119 Wuppertal, Germany
CONTACT PERSON	Mrs. Ljiljana Trivic Ljiljana.Trivic@delphi.com
PREPARED BY	Nikolay Shtin **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Juan Manuel Gonzalez **Name** Authorized Signatory Title: EMC Service Line Manager Western Region
DATED	October 18, 2016

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Revision History

SD72120558-0916ARev1.0 Delphi Deutschland GmbH FI6-125kHz Immobilizer for Keyless Entry System					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
10/17/2016	Initial Release				Juan Manuel Gonzalez
10/18/2016	Initial Release	Rev1.0	Change the Primary Unit stage to Pre-Production, remove all set up pictures to add them in a separate exhibit.	All document.	Juan Manuel Gonzalez

CONTENTS

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SECTION 1

1REPORT SUMMARY

Radio Testing of the
Delphi Deutschland GmbH
FI6-125kHz Immobilizer for Keyless Entry System

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1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Delphi Deutschland GmbH Immobilizer for Keyless Entry System to the requirements of the CFR 47 Part 15, Subpart C and RSS-210 Issue 9.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Delphi Deutschland GmbH
Model Number(s)	FI6-125kHz
FCC ID Number	LTQFI6125
IC Number	3659A-FI6125
Serial Number(s)	N/A
Number of Samples Tested	1
Test Specification/Issue/Date	• CFR 47 Part 15, Subpart C (October 1, 2016) • RSS-210 Issue 9 (August 2016) • RSS-Gen Issue 4 (November 13,2014)
Start of Test	September 23, 2016
Finish of Test	September 26, 2016
Test Facility location	All tests performed on this test report were performed at: TÜV SÜD America Inc. (Mira Mesa Location) 10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400, FAX: 858-546 0364
Name of Engineer(s)	Nikolay Shtin
Related Document(s)	None. Supporting documents for EUT certification and Test Set up pictures are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with CFR 47 Part 15, Subpart C with cross-reference to the corresponding ISED standards is shown below.

Section	FCC	RSS	Test Description	Result	Comments/Base Standard
-	§2.1046(a)		Conducted output power	N/A*	
2.1	§2.1049, §2.202(a)	RSS-Gen 6.6	Occupied Bandwidth	As Reported	
2.2	§15.205, §15.209	RSS-210 4.4, RSS-Gen 8.9 and 8.10	Radiated Emissions	Compliant	
2.3	§15.207(a)	RSS-Gen 8.8	AC Conducted Emissions	N/A**	

N/A* Not applicable. No requirements on the EUT output power.
N/A** Not applicable. EUT is a DC powered device and has no connection to the AC mains.

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1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Delphi Deutschland GmbH FI6-125kHz Immobilizer for Keyless Entry System .

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1.3.2 EUT General Description

EUT Description	Immobilizer for Keyless Entry System
Model Number(s)	FI6-125kHz
Rated Voltage	13.5 VDC (Nominal)
Mode Verified	125 kHz RF Transponder
Device Capabilities	125 kHz RF Transponder
Frequency Range	125.000 kHz
Primary Unit (EUT)	☐ Production
	☒ Pre-Production
	☐ Engineering
Output Power	68.38 dBµV/m @ 3 meters
Number of Operating Frequencies	1
Channel Verified	125.000 KHz
Antenna Type (used during evaluation)	External coil antenna
Modulation Used	ASK

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	EUT in continuous modulated transmission mode reading Key fob transponder.

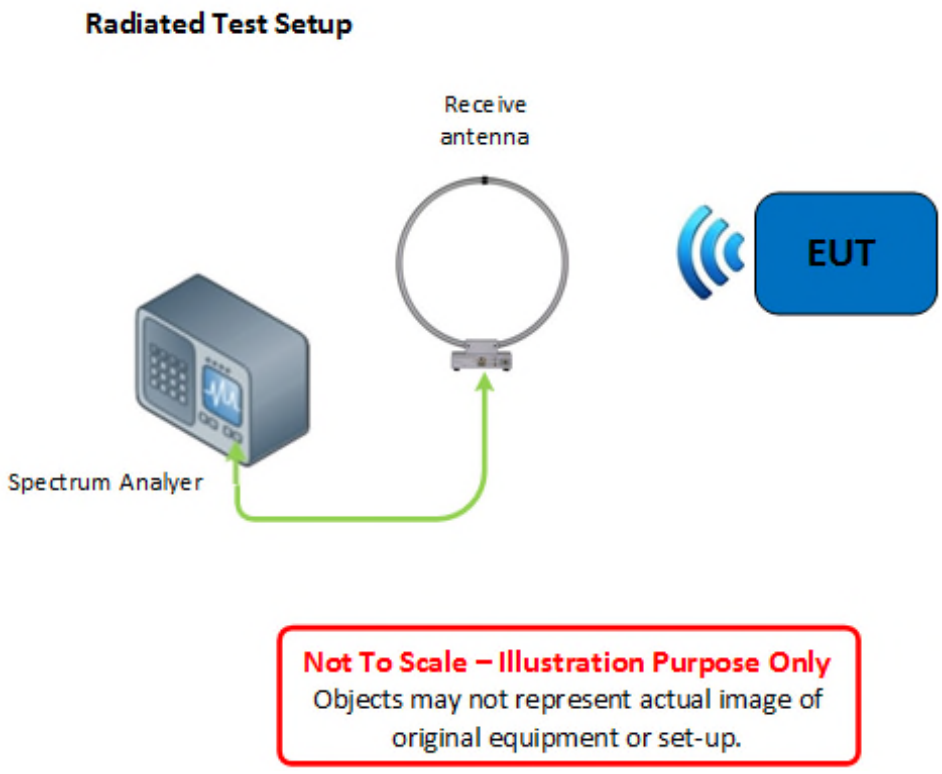
1.4.2 EUT Exercise Software

None. EUT is loaded with H1 IMMO MOD CW software.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Delphi	RF Tool	Device with two key fobs inside (433MHz and 315MHz) and electronic command trigger with transmitting illumination
Delphi	Harness with immobilizer coil, dedicated connectors and LED	

1.4.4 Simplified Test Configuration Diagram



1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: N/A		
N/A	-	-

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 FAX: 858-546 0364

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.498 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.

1.9.2 Innovation, Science and Economic Development Canada Registration No.: 3067A

The Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 VCCI – Registration No. A-0230

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.

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SECTION 2

2TEST DETAILS

Radio Testing of the
Delphi Deutschland GmbH
FI6-125kHz Immobilizer for Keyless Entry System

2.1 OCCUPIED BANDWIDTH

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049 and 2.202(a)

2.1.2 Standard Applicable

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

2.1.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

2.1.4 Date of Test/Initial of test personnel who performed the test

September 26, 2016/NS

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions

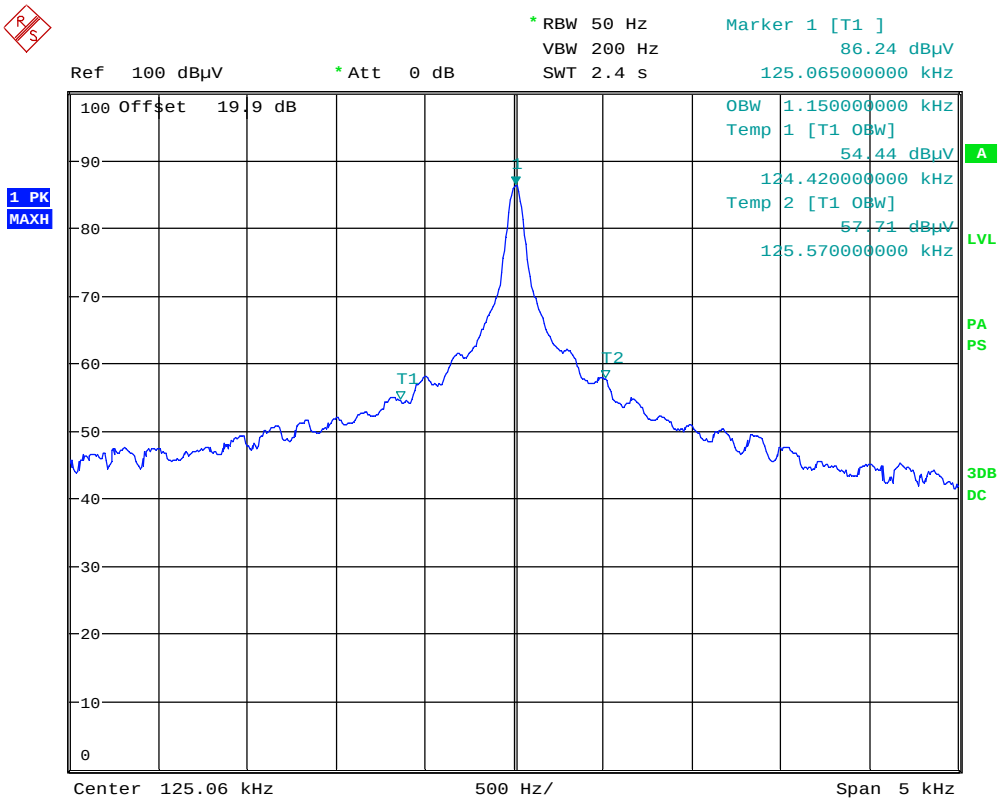
Ambient Temperature	23.8°C
Relative Humidity	43.6%
ATM Pressure	100.2kPa

2.1.7 Additional Observations

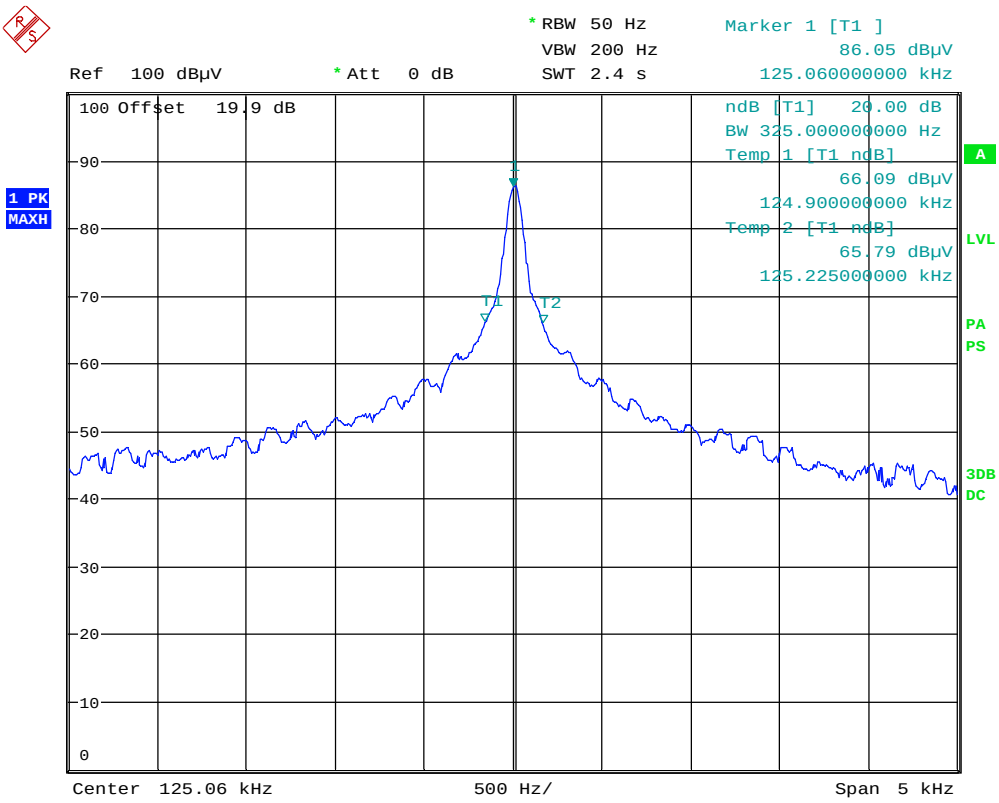
- This is a radiated test using a loop antenna connected to the spectrum analyzer.
- A peak output reading was taken.
- For 99% bandwidth, the OBW measurement function of the spectrum analyzer was used.
- 20dB bandwidth verified using the “n” dB down marker function of the spectrum analyzer.
- Span is wide enough to capture the channel transmission.
- RBW is 50 Hz
- VBW is 200 Hz.
- Sweep is auto.
- Detector is peak.
- Trace is Max Hold.

2.1.8 Test Results

Frequency	20 dB Bandwidth	99% Bandwidth
125.065 kHz	0.325 kHz	1.15 kHz



99% OBW


RBW 50 Hz
VBW 200 Hz
SWT 2.4 s
Marker 1 [T1]
86.05 dBµV
125.060000000 kHz
Ref 100 dBµV
Att 0 dB
100 Offset 19.9 dB
ndB [T1] 20.00 dB
BW 325.000000000 Hz
Temp 1 [T1 ndB]
66.09 dBµV
124.900000000 kHz
Temp 2 [T1 ndB]
65.79 dBµV
125.225000000 kHz
1 PK
MAXH
A
LVL
PA
PS
3DB
DC
T1
T2
90
80
70
60
50
40
30
20
10
0
Center 125.06 kHz
500 Hz/
Span 5 kHz

20 dB BW

2.2 RADIATED EMISSIONS

2.2.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.205 and 15.209
RSS-GEN Issue 4 Sections 8.9 and 8.10

2.2.2 Standard Applicable

§ 15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.		

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

§ 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1] 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			
[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz [2] Above 38.6			

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

2.2.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

2.2.4 Date of Test/Initial of test personnel who performed the test

September 23, 2016/NS

2.2.5 Test Equipment Used

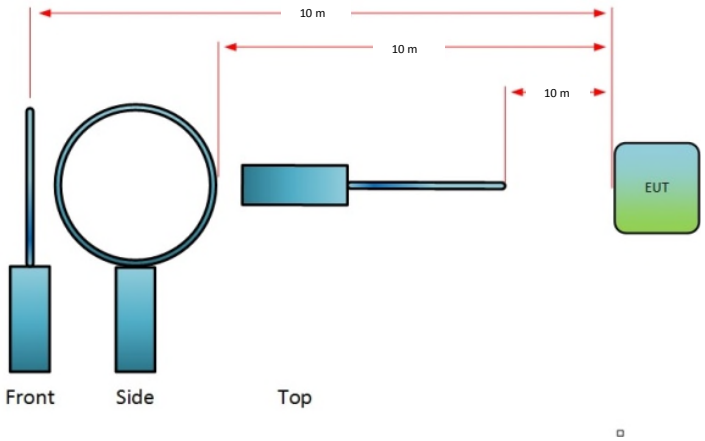
The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions

Ambient Temperature	23.9°C
Relative Humidity	44.1%
ATM Pressure	100.1kPa

2.2.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9 kHz to 1GHz.
- Below 30MHz, prescans were performed to determine best test antenna orientation with the highest recorded emissions. Verification was performed using "Side" configuration (see the figure below) corresponding to the best antenna orientation as found during the prescans.



- The EUT was verified with antenna in. Only the worst case configuration presented ("X" Axis).

- Measurement was done at 3 meters. Limits below 30 MHz were corrected using extrapolation factor of 40 dB/decade. See sample computation below:

  Limit @ 9kHz = 2400/F(kHz) µV/m
  = 20 log (2400/9) dBµV/m
  = 48.52 dBµV/m @ 300 meters
  = 48.52 dBµV/m + (40 log 300/3) @ 3 meters
  = 128.52 dBµV/m @ 3 meters

- Measurement was done using EMC32 V9.26.0 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Sections 2.2.8 and 2.2.9 for sample computations.

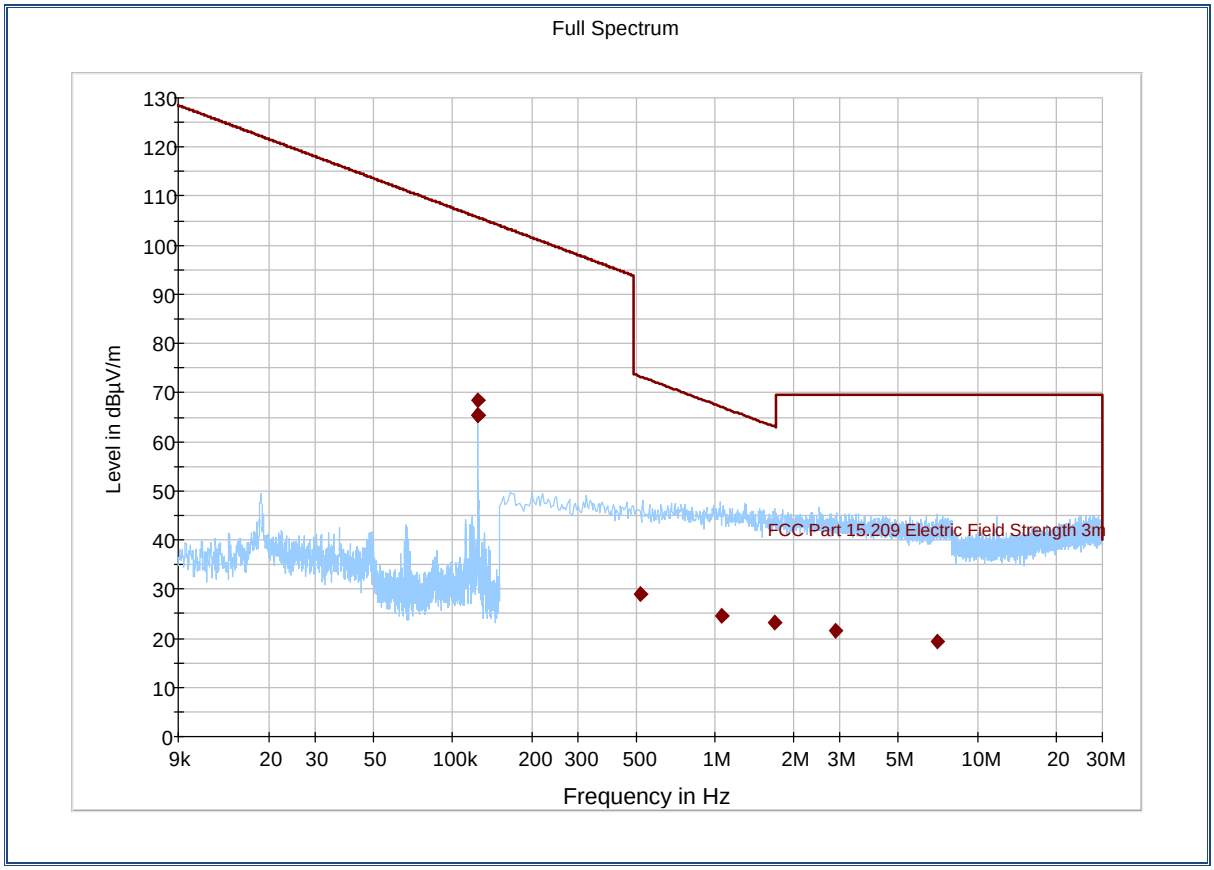
2.2.8 Sample Computation (Radiated Emission 9kHz to 30MHz)

Measuring equipment raw measurement (dbµV) @ 9 kHz			25.0
Correction Factor (dB)	Asset# 1057 (cable)	0.1	24.8
	Asset# 8850 (cable)	0.3	
	Asset# 6628 (antenna)	24.4	
Reported QuasiPeak Final Measurement (dbµV/m) @ 9kHz			**49.8**

2.2.9 Sample Computation (Radiated Emission 30MHz to 1GHz)

Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 8850 (cable)	0.3	
	Asset# 1033 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.2.10 Test Results (Worst Case Orientation 9kHz to 30MHz)

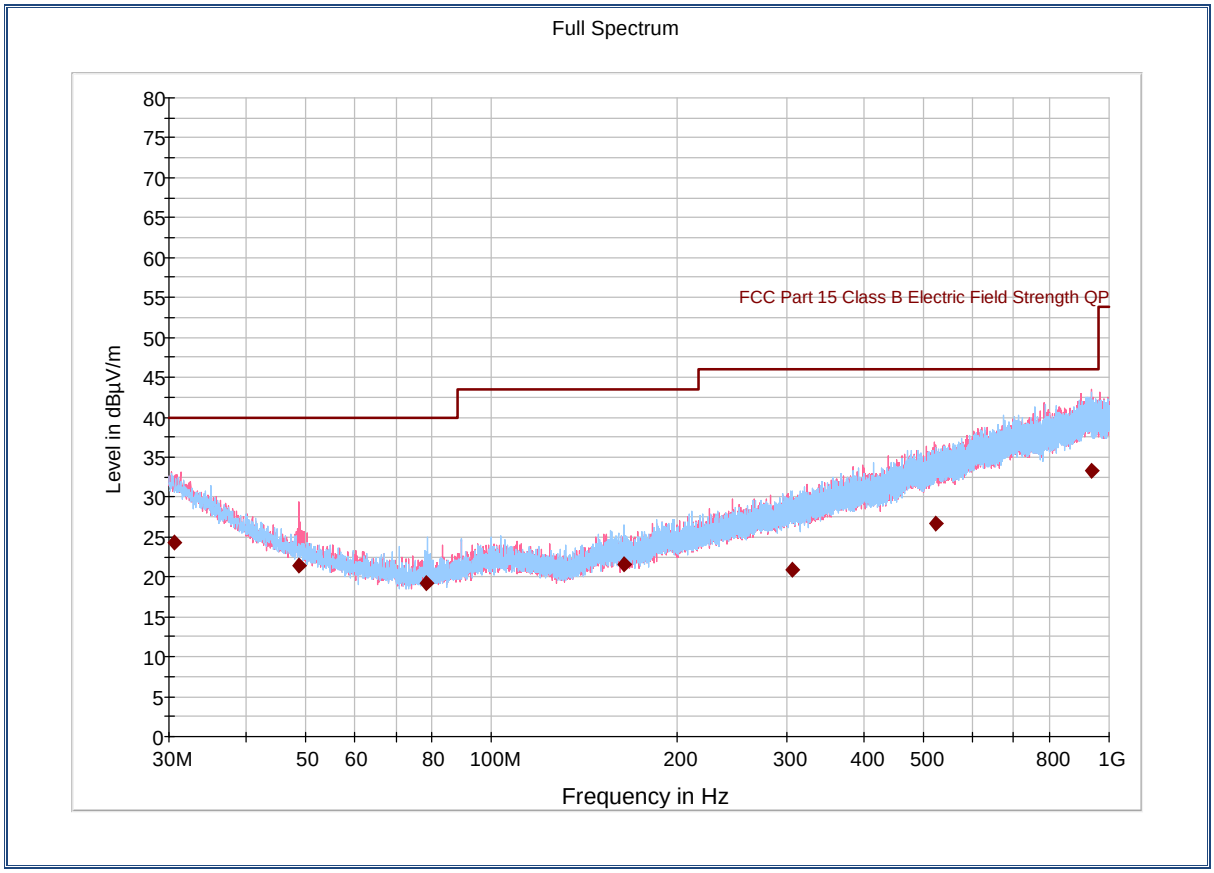


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
0.125039	68.38	1000.0	0.200	100.0	H	146.0	19.9	37.28	105.66
0.125077	65.35	1000.0	0.200	100.0	H	35.0	19.9	40.31	105.66
0.125091	65.40	1000.0	0.200	100.0	H	33.0	19.9	40.26	105.66
0.521670	29.11	1000.0	9.000	100.0	H	87.0	20.0	44.14	73.26
1.058985	24.63	1000.0	9.000	100.0	H	320.0	20.2	42.47	67.10
1.691745	23.17	1000.0	9.000	100.0	H	309.0	20.2	39.86	63.03
2.894685	21.46	1000.0	9.000	100.0	H	104.0	20.2	48.04	69.50
6.995075	19.38	1000.0	9.000	100.0	H	144.0	20.3	50.12	69.50

Test Notes:

2.2.11 Test Results (Worst Case Orientation 30MHz to 1GHz)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.645667	24.34	1000.0	120.000	109.8	V	297.0	24.5	15.66	40.00
48.785667	21.32	1000.0	120.000	108.1	V	88.0	16.4	18.68	40.00
78.543333	19.27	1000.0	120.000	340.6	H	132.0	13.7	20.73	40.00
164.094000	21.58	1000.0	120.000	185.3	H	322.0	16.8	21.92	43.50
307.200667	20.91	1000.0	120.000	329.5	H	195.0	22.3	25.09	46.00
523.819667	26.69	1000.0	120.000	126.3	V	358.0	27.7	19.31	46.00
935.418667	33.25	1000.0	120.000	310.9	V	26.0	33.3	12.75	46.00

Test Notes:

SECTION 3

3TEST EQUIPMENT USED

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3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Emission						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
6628	Loop Antenna	HFH 2 –Z2	880 458/25	Rhode & Schwarz	10/28/15	10/28/16
8878	High-frequency cable	R90-088-240	N/A	Teledyne/Storm Microwave	03/16/16	03/16/17
8879	High-frequency cable	084-0505-100	N/A	Teledyne/Storm Microwave	03/16/16	03/16/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
Miscellaneous						
	Test Software	EMC32	V9.26.0	Rhode & Schwarz	N/A	
7619	Barometer/Temperature/Humidity Transmitter	iBTHX-W	15250268	Omega	10/19/15	10/19/16
6455	DC Power Supply	E3611A	2529	HP	N/A	

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

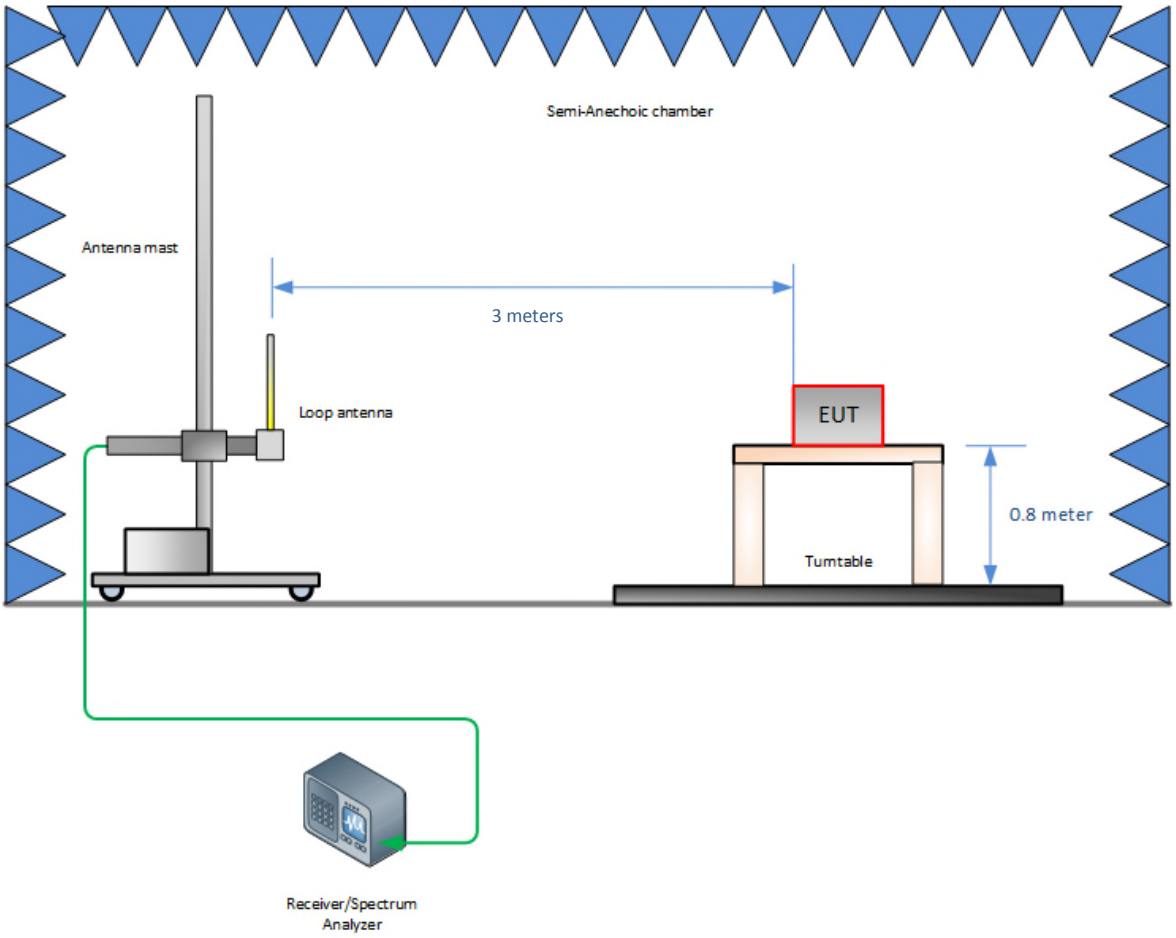
3.2.1 Radiated Emission Measurements

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.78
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.57

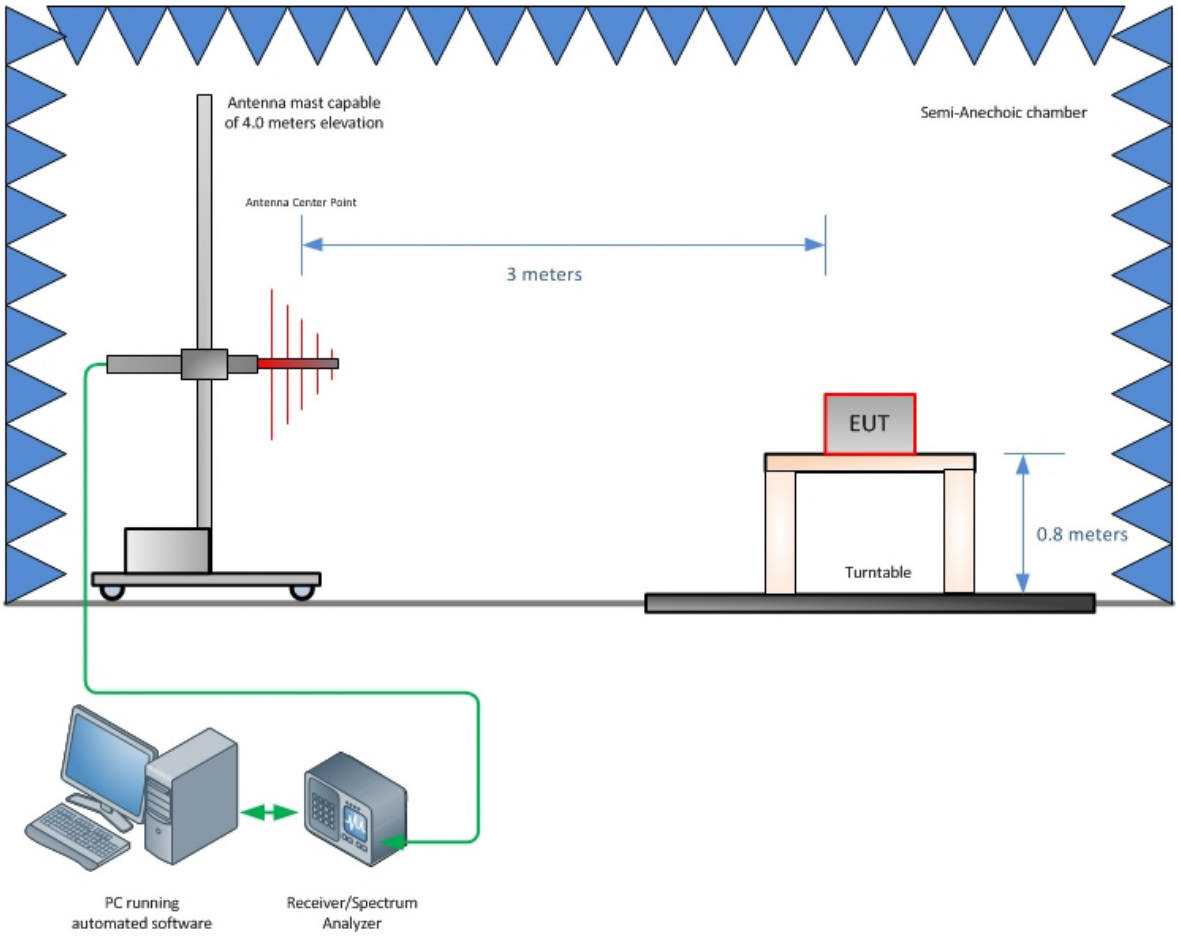
SECTION 4

4DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 30 MHz)



Radiated Emission Test Setup (30MHz to 1GHz)

SECTION 5

5ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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